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*Annual Report*

*SRI-ARC 10045*

*Covering the Period 15 April 1971 through 15 April 1972*

## **EXPERIMENTAL DEVELOPMENT OF A SMALL COMPUTER-AUGMENTED INFORMATION SYSTEM**

*By: D. C. ENGELBART, Director  
Augmentation Research Center*

*Prepared for:*

INFORMATION SYSTEMS BRANCH  
OFFICE OF NAVAL RESEARCH  
DEPARTMENT OF THE NAVY  
ARLINGTON, VIRGINIA 22217

Attention: MR. A. KENNETH SHOWALTER

CONTRACT N00014-70-C-0302



**STANFORD RESEARCH INSTITUTE**  
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SRI Project 8622

*Approved by:*

BONNAR COX, *Executive Director*  
*Information Science and Engineering Division*

*Copy No. .... 66*



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## INTRODUCTION

1

The ONR Research Contract No. N00014-70-C-0302 is a development project on a small computer-augmented information system oriented toward serving the "intelligence" needs of a research (and/or development) community. We call the system "RINS" (Research INtelligence System).

la

Over the years, the Augmentation Research Center (ARC) has developed an extensive set of computer tools and techniques. Among these is an emerging set designed to aid the management of our computer-held files and memos. Developments toward this end have been made (mainly by ARPA-supported activity) in the following areas:

lo

(1) Special catalog files, with structure and syntax conventions for encoding arbitrary types of data elements into individual "entries," each of which describes some discrete item that is to be kept track of, searched for.

lbl

(2) Special computer processes for:

lb2

(a) Analyzing a catalog entry for the nature and content of its data elements

lb2a

(b) Collecting a desired set of entries from the catalog files by scanning a specified set of catalog files and selecting entries according to specified content analysis (which may be directly programmed and compiled by the user)

lb2b

(c) Sorting the entries selected by content analysis into new order depending upon (multilevel) sort keys extracted and generated during the analysis of each entry

lb2c

(d) Formatting information extracted (or conditionally generated) from an entry by an analysis process into an arbitrary display/printout format

lb2d

(3) Methods for producing hard-copy listings and indices for any given sub-collection of items, using special versions of all of the above processes.

lb3

Within the ARC, RINS is a relatively small project in a long-term activity, all of whose components are continuously developing. RINS is intended to become an operating intelligence system that will supply an active community of system developers with what they need to know about their

outside world. Initially (during the current ONR-supported phases), RINS is being developed to serve the 35 people in ARC.

lc

It is ARC's plan to expand steadily the number of R&D groups that interact and collaborate to mutual advantage via computer-network and on-line services. In the planned future, RINS would serve the aggregate needs of these groups for collecting and digesting intelligence data about products, techniques, concepts, and activities pertaining to computer-systems development and operation.

lc1

The fact that ONR is supporting development work on a research intelligence system carries no implication as to who will support the subsequent operation of such a system. ARC's assumption is that the operating costs will be borne by the party or parties making use of the system.

lc2

## SUMMARY OF RINS ACTIVITY

2

During this second year, ARC has put its major effort into three of the four categories in its investigation effort: the development of augmented management and operational techniques for running a research intelligence system, the further building of the data base, and the improvement of the computer aids supporting the processes.

2a

We have explicitly established a "People Services Operation," providing organized supporting operations, with developing procedures that aid in the throughput of incoming information and its entry into the data base.

2a1

We have continued the building of a reference data base. Procedures have been developed for improved citation form and citation file building, and many documents have been recorded with these procedures.

2a2

We have also directed effort toward the development of a coordinated automatic process for entry and storage of catalog data and for catalog and index production.

2a3

A fourth activity -- integration of the RINS developments into the working life of ARC researchers and ARPA Network Information Center (NIC) users -- has been delayed.

2a

Use of the ARPANET has been slower to evolve than we expected, and the efforts required of ARC in that activity were much heavier than expected -- consequently, the ARC staff has been too involved with operational tasks to

participate in the research use of an intelligence data base.

2b1

In regard to ARC's giving NIC users access to the RINS developments, it should be noted that because of the recent extension plans for the ARPANET membership, it may well prove unsuitable to offer RINS data and tools to the whole community being served by the NIC. ARC plans instead to involve only selected Network users.

2b2

### PEOPLE SERVICES OPERATIONS (PSO)

3

During the past year ARC has developed several service functions (mainly under our ARPA-supported contract) that are now becoming operational for ARC users and in some cases providing service to external users.

3a

These functions (from activities such as RINS, NIC, Baseline Record, and Journal) and the forthcoming use of new Deferred EXecution (DEX) techniques have created several new types of needs for people services support.

3b

As a result, we concentrated some of our effort on reorganizing these activities to allow more effective and efficient handling of routine and other tasks and to allow for easier expansion of the group size to meet needs for an increasing amount of throughput. The three aims were:

3c

Getting the throughput up to meet demands.

3c1

Getting in position to be rapidly expandable (in throughput quantity) to meet fluctuating service demands.

3c2

Working at minimizing costs while maximizing responsiveness to customers' needs/values.

3c3

We launched a new approach to ARC's "people services operations". (see -- 7834,1a)

The main thrusts were:

3d

Organization

3d1

Physical Location and Configuration

3d2

Procedure Establishment and Documentation

3d3

Transcription Activities

3d4

Terminals

3d5

Personnel

3d6

Training

3d7

Organization

A group with skills in handling paperwork and messages, in using TNLS and DEX, was explicitly identified as PSO, and a group of advisors with skills in administration, documentation, and training was assigned to assist in getting PSO into formal operation.

3e

Physical Location and Configuration

Office and workroom areas were expanded and relocated, to give the growing support operations more efficient location and arrangement. New tables, shelves, cabinets, and files were acquired and their configurations worked out.

3el

3f

Procedure Establishment and Documentation

Manuals and procedures were written for use of TNLS (see -- 7470,) and DEX (see -- 9934,).

3g

3gl

Procedures were established and written for handling of transcription and other service requests.

3g2

Procedures for all related ARC activities, clerical and secretarial, were established and documented.

3g3

Transcription Activities

Types of work to be handled:

3h1

Handwritten drafts

3h1a

Tape recordings

3h1b

Dictation notes

3h1c

Off-line documents

3h1d

On-line documents to be edited

3h1e

Techniques for transcribing material into on-line files were developed:

3h2

Deferred Execution (DEX)

3h2a

This process (developed on an ARPA-supported contract) makes use of terminal and magnetic tape recording equipment for initial input of data with actual entry into computer files deferred until periods of relatively low system use (thereby resulting in less expensive use of the system for the processing of this work).

3h2al

DEX is preferred for most work. Pieces of work can be spooled by priority.	3h2a2
Where and how long to store entered tapes for backup, the conventions for hierarchical statement entry treatment, and when the transcriber should try to put hierarchical structure into documents are still under development.	3h2a3
TNLS	3h2b
In some cases TNLS is used, particularly for high-priority items during off-peak load hours.	3h2b1
DNLS	3h2c
Display NLS is used for otherwise difficult final formatting and other appropriate tasks.	3h2c1
Receiving process	3h3
We set up a central receiving station.	3h3a
There is one person with an alternate who can handle users' questions regarding job status, time and cost estimates, etc.	3h3b
Priority determination process	3h4
A requester specifies his preference for priority:	3h4a
Immediate service (1-4 hours)	3h4a1
Normal service (4-12 hours)	3h4a2
Deferred service (a week or two)	3h4a3
Temporary storage of unassigned work	3h5
A log system using appropriate work request forms has been set up.	3h5a
We have a central storage place, organized for control of work by priority.	3h5b
Assignment process for transcription work	3h6
A work scheduler assigns incoming work to group members, balancing priority request with members' capabilities and workload.	3h6a

Later, priorities may be established by a bidding scheme.

3h6b

It is contemplated to enlarge this effort to allow assignment to an outside pool of workers trained in DEX, both SRI people and contract manpower.

3h6c

Output processes

3h7

We have developed conventions for naming of temporary input files (special and separate for the catalog process) with provision for special instructions from the author.

3h7a

We have developed procedures for delivery of completed work to the requester.

3h7b

Terminals

3i

We have made a thorough study of available teletype terminals and magnetic tape devices, and after experimental use of several, have leased nine TI terminals and six Termicettes, for use with DEX.

3i1

Personnel

3j

We have added several new staff members with contributions to make to RINS. Two writers who can also teach were active in PSO development. Three new staff were added to the document preparation, transcription and distribution efforts.

3j1

Training

3k

Classes in TNLS and DEX were held for ARC and network people. Manuals were prepared.

3k1

## BUILDING A REFERENCE DATA BASE

4

Selection of additions to the data base

4a

The ARC Master Catalog is a group of files containing the catalog-entry statements for all informational items that we hold for purposes of control, retrieval, and access.

4a1

Active experimentation in the collection of information items and interaction with other existing data bases is still in the future plans of ARC. However, during the past year ARC took the opportunity to input the contents of some

data bases gathered elsewhere, and to output the contents in new formats.

4a2

Data bases thus added include:

4a3

A bibliography prepared for use of the attendees at the January 1971 AFIPS Workshop on the User Interface. The bibliography and indexes processed by ARC programs were published in the volume of Proceedings of the Workshop. (see -- 9474,)

4a3a

An extensive bibliography on networking prepared by Peggy Karp of MITRE. Each reference cited was obtained in full-size copy and was coded and entered in the Master Catalog. (see -- 6025,)

4a3b

Special "subcollection catalogs", such as for the NAS Information Sciences Panel, for the AFIPS Workshop, for the ARC Journal or for the Network Information Center, are created by (automatically) collecting a copy of every entry statement in the Master Catalog having a descriptor code of NAS, AFI, JOU or NIC respectively in its "\*z2 field."

4a4

Design of data elements

4b

Usefulness of a data base of citations to information items depends on the elements of data selected to describe the items. The selection criteria and their implementation become even more important when the items of information include forms of information other than published books, articles and reports, e.g., films, slides, letters, photos, ads, meeting agenda, maps.

4b1

A continuing effort has been the refinement of a set of data elements. The requirements are:

4b2

Data elements should be adequate to describe all species of information items which are anticipated to be added to the RINS collection.

4b2a

Data elements should be adaptable to economical use by programs developed for gathering and formatting the citations into catalogs and listings and for on-line retrieval.

4b2b

The present list of data elements and guidelines defining their application is appended. (see -- 9868,)

4b3

Entry of items into the data base

4c

As noted, items of information relevant to ARC appear in many forms. Reference to these items is simplified by assigning a master catalog number, a serial number, to each. To record the item to which the catalog number refers, a description of the item using the data elements noted above is coded by ARC and entered as a "statement" in an NLS file.

4c1

Procedures necessary to ensure a consistent, clean, data base are vital and difficult to hammer out. Much effort has gone into this area over the past year.

4c2

An example of a catalog-entry statement with typical coded data elements:

4c3

(A6088) \*al A. W. Whiteney \*a2 W. E. Blasdell #2 org \*b2 General Electric Company #3 Electronics Laboratory #5 Syracuse, New York \*cl Study of Computer Graphics and Signal Classification Applications #1 Final Technical Report #6 147p. \*d1 September 1970 \*d3 17 March 1969 to 17 April 1970 \*f1 r \*f2 o \*r2 RADC-TR-70-148 \*s1 Rome Air Development Center #3 Air Force Systems Command #5 Griffiss Air Force Base, New York #6 F30602-69-C-0227 #7 5581 #9 Task 558104 #w2 2-2-71 \*y1 Signal classification problems, Technical or signal preprocessing and classification, Functional description of a system, Software requirements and system design. \*z3 new \*

4c3a

Design of catalog formats

4d

A set of special programs has been written at ARC to collect, sort, analyze, and reformat the entry statements to produce catalogs and indices such as those in the Current Catalog of the NIC Collection, (see -- 5145,) and those used in NAS Panel and AFIPS Workshop meetings.

4d1

These programs, described below, are the result of much thinking and experimentation to produce catalogs and indexes of maximum usefulness, given the present printing constraints.

4d2

Examples of the listings and indexes now produced are:

4d3

Catalog listing by number:

4d4

Study of Computer Graphics and Signal Classification Applications 6088  
(Final Technical Report).  
A. W. Whiteney and W. E. Blasdell (General Electric Company,  
Electronics Laboratory, Syracuse, New York).  
September 1970. (147 p.)  
Signal classification problems, Technical or signal  
preprocessing and classification, Functional description of a  
system, Software requirements and system design.

SRI-ARC 24 APR 72 10045  
 Annual Report for ONR Research Contract N00014-70-C-0302

Author index:

4d5

NWG/RFC 172: The File Transfer Protocol (In 7104) (See Number Listing)	23	Jun	71	6794	+	White
NCP Operator's Guide	4	Jun	71	6797	+	White
Response to NIC 7123, NWG/RFC 180	30	Jul	71	7166	+	White
NWG/RFC 206: A User TELNET - Description of an Initial Implementation	9	Aug	71	7176	+	White
Study of Computer Graphics and Signal Classification Applications	Sep	70		6088		Whitney
A Study of Optimal File Assignment and Communication Network Configuration in	Sep	70		7434		Whitney
Response to LISP (NIC 5628) and Data Management (NIC 5629) Inquiries	14	Jan	71	5667	+	Wilber
NWG/RFC 152: SRI Artificial Intelligence Status Report	10	May	71	6756	+	Wilber
The Design of Multiple-Access Computer Systems, Part 1			May	67	6437	Wilkes

Titleword index:

4d6

NWG/RFC 192: Some Factors which a Network Graphics Protocol Must Consider	12	Jul	71	7137	+	Graphics
NWG/RFC 191: Graphics Implementation and Conceptualization at ARG	13	Jul	71	7130	+	Graphics
NWG/RFC 199: Suggestions for a Network Data-Tablet Graphics Protocol	15	Jul	'71	7151	+	Graphics
Research Activities during 1970 under the Lincoln Laboratory Graphics	Feb	71		5645	+	Graphics
Study of Computer Graphics and Signal Classification Applications	Sep	70		6088		Graphics
Video Graphics Keyboard and Terminal Characters	Undated			5789		Graphics
Final Report of a Study Group on Speech Understanding Systems	1	Feb	71	6018		Group
Forum	1	Dec	70	6195		Group
Forum	1	Jan	'71	6000		Group

Number index:

4d7

Pearlman	A Communications Environment Simulator	69	6133	+
Newport	A Panel Session - Small Computers for Data Terminal Network Control	69	6132	+
Ward	A Panel Session - Software Transferability	69	6131	+
Kutledge	An Interactive Network of Time-Sharing Computers	69	6130	+
Postel	Letter expressing interest in file archival experiments and online documentation	25	Mar	71
	UCLA Computer Science Site Profile	22	Mar	71
Whitney	Study of Computer Graphics and Signal Classification Applications	Sep	70	6088
Krutar	Conversational Systems Programming	3	Mar	71
Lisle	(transmittal letter for 6035)	10	Mar	71
North	Transmittal to NIC Station Agents - 13	24	Mar	71
Gibson	(transmittal letter for 5775)	19	Mar	71
				6030

COMPUTER-PRODUCED CATALOGS AND INDEXES

5

Introduction

5a

We have directed effort toward the development of a Catalog Support System (CSS), needed initially to support clerical processes for maintaining current on-line catalogs of the Master Collection and several subcollections and for producing various indices (hardcopy and on-line) to these collections. Subsequently, support will be needed for augmenting various on-line user-level information-handling processes.

5a1

The CSS is concerned with the following principal processes:

5a2

Input, editing, proofing, and verification of catalog entries.

5a2a

Updating of the Master Catalog and subcollection catalogs.

5a2b

Production of incremental and cumulative, hardcopy and on-line indices to various collections.

5a2c

Overall Design Goals and Elements

5b

The basic goals relevant to providing aids to these processes are:

5b1

Maintaining integrity of the master catalog files with maximum protection from both human and mechanical errors.

5b1a

Making possible a smooth flow of input from ARC clerks with good facilities for proofing and correcting all clerical input.

5b1b

Removing as much load as possible from the computer system during prime use times through the use of Deferred Execution techniques.

5b1c

The initially implemented element of the Catalog Support System is the Catalog Production Processor (CPP).

5b2

The CPP is the basic output port of the CSS and is designed to allow the production of on- and off-line, incremental and cumulative, indices and listings of various kinds, using the Master Catalog as the ultimate data base.

5b2a

One objective in the design of the CPP, in fact of most of the CSS, is not to add new basic capabilities to our augmentation system, but rather to bring together existing ones in such a way as to reduce our commitment of resources to clerical tasks.

5b2b

The basic design goals which the CPP must meet are the following:

5b2c

It should permit flexible specification of the types and frequencies of production of the various catalog indices and listings needed by DSS, NIC, DPCS, etc.

5b2c1

It should function as automatically as possible and with a minimum consumption of ARC personnel and equipment resources.

5b2c2

The CPP implementation has now progressed to the stage of final testing and is expected to be used

operationally in the production of the next ARC Journal and NIC Catalogs in the next few weeks.

5b2d

Use with the entire ARC Master Collection as an aid to completely integrating the various subcollection citations will follow. The CPP will then be available for ARC use on any desired subcollection catalog-production work, either Journal, NIC, or special subsets.

5b2d1

#### SUMMARY OF INVESTIGATION PLANNED DURING THE COMING YEAR

6

ARC plans the following activities for the next (third) year of ONR-sponsored development of our Research Intelligence System.

6a

We plan to continue on our present course, with the following developmental tasks:

6b

(1) Add to our developing research-intelligence data base over a limited subject domain.

6b1

(2) Continue integrating the data base and tools of RINS into the working life of ARC researchers and selected Network users.

6b2

(3) Add to or modify the computer aids that will be used to support RINS processes.

6b3

(4) Continue developing augmented management and operations techniques for running the research-intelligence process.

6b4

We assume that a steady addition of other resources will become available for the development of the RINS data base and supporting techniques -- a cooperative activity that ARC at present considers calling its System Developer's Intelligence Service (SDIS).

6c

The SDIS data base will be directly oriented to the needs of people doing research in or development of computer-based information systems.

6c1

ONR's funding will represent the initialization resource for what is expected to become a set of resources from a number of sources.

6c2

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1. ARC 7834, J. C. Norton, "Outline for Establishing People Service Support Team (PSST)," Augmentation Research Center, Stanford Research Institute, Menlo Park, California, 2 November 1971. 7a

2. ARC 7470, "NIC TNLS User Guide," Functional Document, Augmentation Research Center, Stanford Research Institute, Menlo Park, California, 23 September 1971. 7b

3. ARC 9934, "Deferred Execution User Guide," Augmentation Research Center, Stanford Research Institute, Menlo Park, California, April 1972. 7c

4. ARC 9474, "Interactive Bibliographic Search: the User Interface," Proceedings of the Workshop, AFIPS Press, 1971. 7d

5. ARC 6025, P. M. Karp, "Bibliography of Literature on Computer Networking," (at MITRE Corporation), December 1970. 7e

7. ARC 5145, "Current Catalog of the NIC Collection," Functional Document, Augmentation Research Center, Stanford Research Institute, Menlo Park, California, April 1972. 7f

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2. ARC 5139, D. C. Engelbart and Staff of Augmentation Research Center, "Computer-Augmented Management-System Research and Development of Augmentation Facility," RADC-TR-82, Final Report of Contract F30602-68-C-0286, SRI Project 7101, Stanford Research Institute, Menlo Park, California, April 1970. 8b

3. ARC 5140, D. C. Engelbart and Staff of Augmentation Research Center, "Advanced Intellect-Augmentation Techniques," Final Report NASA Contract NAS1-7897, SRI Project 7079, Stanford Research Institute, Menlo Park, California, July 1970. 8c

- 4. ARC 5255, D. C. Engelbart, "Intellectual Implications of Multi-Access Computer Networks," paper presented at the Interdisciplinary Conference on Multiple-Access Computer Networks, Austin, Texas, April 20-22, 1970. 8d
- 5. ARC 8276, D. C. Engelbart, "Experimental Development of a Small Computer-Augmented Information System," Annual Report, Office of Naval Research (ONR) Contract N00014-70-C-0302, SRI Project 8622, Stanford Research Institute, Menlo Park, California, April 1971. 8e
- 6. ARC 8277, D. C. Engelbart and Staff of Augmentation Research Center, "Network Information Center and Computer-Augmented Team Interaction," Interim Report, Air Force (RADC) Contract F30602-70-C-0219, SRI Project 8457. Stanford Research Institute, Menlo Park, California, July 1971. 8f

APPENDIX 9

- ARC 9868, J. B. North, "Codes Used in the Master Catalog," Augmentation Research Center, Stanford Research Institute, Menlo Park, California, January 1972. 9a



## CODE-MANUAL (Codes used in the Master Catalog)

## GENERAL

## Abbreviations

Abbreviation is avoided except in copying any actually present in proper names and titles.

## Exceptions:

Codes of ARPA network sites may be entered in \*a#2 and \*b5#2, but only in citations for informal documents.

Code "org" may be entered in \*a#2 when information is identical to \*b2 or \*b4. See \*a1 for further information.

## Added information

Information known or very probable and of importance to the reference, such as an unstated author, organization, date of publication, should be given in brackets [ ].

In general, only information actually in the document is to be recorded. Recording presumed information is risky, and is poor practice also because copies of the document don't carry the information thus supplied.

## Proper names

All proper names will be entered in direct order, omitting only "the", beginning corporate names, and any title in personal names.

## Document reference numbers

These numbers will be typed without parentheses; and if there are more than one, without commas between them, just a space. i.e., \*nl 5891 5892 5893

## \*a1 FIRST AUTHOR --

Author's name, as given, in direct order, omitting Dr., Ph.D., etc. (No limit to number of authors.)

## #1 JOB TITLE --

If given in the document.

## #2 CORPORATE AFFILIATION --

If the author's organization is the publisher of the document, enter the letters "org" in #2, as the same information can be retrieved from \*b2 (see below for multiple authors). For ARPA Network nodes, this may be entered in the code: "ARC", "LINC", etc. If author's organization is not the publisher of the document, as in a periodical article or meeting proceedings, enter the organization information as given. When two or more consecutive authors of an article have the same org, enter the org after the last. When \*b2 is used and two or more consecutive authors have the same org, type "org" in #2 after the last author of these. For other notes on organization names, see notes on \*b2.

## #3 SUBORGANIZATION --

If more than one subordinate level is given, select one.

## #4 STREET ADDRESS --

Use this element for building name or number, suite number, or other specific of address when practicable, the intent being to allow construction of a mailing address from #1-#5. When an organization, e.g., Chemical Abstracts Service, is situated at another org, but is not a sub-org, use #4 for the site, e.g., Ohio State University. cf. \*b2#2.

## #5 CITY, STATE, ZIP --

Spell out, e.g.: Washington, D.C. 20202; New York, New York 10036; Menlo Park, California 94025.

## #7 IDENT --

Not used for manual input; supplied by journal.

## \*b2 FIRST ORGANIZATION --

Use for agency preparing or issuing a report, or other case of non-commercial publisher. For agencies, such as National Library of Medicine, which usually appear independently, enter these as \*b2, not as subordinate to U.S. HEW. Ambiguous names, such as Office of Education, should be entered in #3, with U.S. HEW as \*b2.

## #2 INTERMEDIATE ORGANIZATION --

Use when essential to completeness, as in some government organizations. Always use #3 for significant suborganization, inserting #2 when essential.

## #3 SUBORGANIZATION --

Use for significant suborganization, skipping #2 unless an intermediate is important for clarity. Avoid using when an organization is a smaller unit, e.g., an Institute, but only based physically at the larger, such as a university. Place the Institute in \*b2, and the university in \*b2#4.

## \*b3 SECOND ORGANIZATION --

Use for a second agency (not a government sponsor) in case of joint effort resulting in a document bearing both names.

## \*b4 PUBLISHER --

Use for commercial publishers, when documenting books, or noting periodicals as entities.

**\*b5 FIRST ADDRESSEE OF LETTER OR MEMO --**

To be used, even when addressee list is so lengthy as to cause use of \*b9. Can be a group or class, even when non-explicit, such as (ARPA Network Working Group). Use ident, in \*b6. Use form of address in #1, #2, etc. Given in the document, do not try to standardize (NOTE: 1. No control over outside entries. 2. Retrieval may be by entry as given, as often as not).

**\*b6 through \*b8 additional addressees****\*b9 ARC DOCUMENT NUMBER OF ADDRESSEE LIST --**

When an addressee list is attached, or when list of addressees exceeds 4, a separate document should be indicated or created, and referenced here.

**\*b10 DISTRIBUTION LIST IN IDENT FORM --**

For group ident, when addressed to Network Working Group or other recognized group whose membership is given in its ident file.

**\*c1 TITLE OF ITEM --**

Title of report, article, book or journal considered as a whole. When a memo contains the line "Subject: ..." or "Re: ..." this text, including "Subject:" or "Re:", is entered as the title. Title is essential; letters with no explicit title should have descriptive title in brackets. Example: (transmittal letter). When the item referenced is a review or abstract of another work of the same title, add (review) or (abstract). Limitation on use of a document should be indicated by (L) following the title, with an elaboration in \*y1.

**#1 SUBTITLE --**

Include any subordinate phrase in the title rather than as subtitle, as a rule. Use subtitle only for lengthy title strings or for alternate titles, and for series notes. Vol. 1 etc. of books goes into subtitle when subtitle is title of vol. only.

**#6 PAGES --**

Use for page data when \*c2 is not present or when \*c1 is independently paginated. Examples: 263r. (for book with 263 pages).

**\*c2 TITLE OF MORE INCLUSIVE DOCUMENT --**

Use for name of journal when \*c1 is an article from it. Use for name of book when \*c1 is a chapter from it. Use for Proceedings when \*c1 is a paper published in it. Use for encyclopedic work or series when \*c1 is a volume from it. Use for functional document name when \*c1 is a part or section of contents. Example: Section 3, Network User Guide.

**#1 SUBTITLE --**

Use only when inclusion in \*c2 is awkward.

Examples: \*c2 MICRODOC #1 Journal of the Microfilm Association of Great Britain -or- \*c2 Bulletin de Documentation Bibliographique #1 Pt. 2 of Bulletin des Bibliotheques de France.

**\*2 VOLUME --**

Examples: Vol. 35, for volume of periodical. Vol. 35 for volume of encyclopedia or a series. Vol. 1, etc. of books goes into subtitle when subtitle is title of vol. only.

**#3 NUMBER --**

Use for issue number of periodical. Examples: No. 10 No. 106 when no volume number exists.

**#6 PAGES --**

Use for articles or other parts of documents. Include p. Example: p.256-275

**\*c4 ALSO PUBLISHED IN: --**

When such information is given. Use \*d5 for date.

**\*c5 ALSO PUBLISHED AS: --**

When such information is given. Use \*d5 for date.

**\*c6 ALSO TO BE PRESENTED AT: --**

For reports or articles which contain such a statement. Code as \*fl p after \*fl r or \*fl s. Use \*d5 for date.

**\*d1 DAY AND/OR MONTH AND/OR YEAR ISSUED --**

Use for all types of items. Use for date of publication of published items, for date of letter or memo. Use \*d2 if an earlier date of preparation is given. Use \*d4 for a meeting date or dates whether the same as or different from \*d1. Use form: 12 November 1969.

**\*d2 DATE WRITTEN OR SUBMITTED --**

Use in addition to \*d1 when an earlier date of preparation or submission is shown. Use form: 12 November 1970.

**\*d3 PERIOD COVERED --**

Use for progress reports, etc., when indicated by cover, title or abstract. Use form: 1 July 1969 - 30 June 1970.

**\*d4 DATE OF CONFERENCE OR MEETING --**

Use in addition to \*d1 whether or not \*d1 gives date of published proceedings. Use form: 12-15 November 1970  
30 November - 2 December 1970

\*d5 DATE OF \*ch, \*c5 or \*c6

\*d6 DATE OF FILE REVISION --  
Example: 1/20/72

\*d7 TIME OF FILE REVISION --  
Example: 1920:32

\*f1 FORM OF ITEM --

NOTE: MULTIPLE CODES MAY BE USED, e.g., r o - numbered report to be given at a meeting; a tr - translation of an article. FIRST CODE DETERMINES FORMAT. This element has two uses: formatting for the printed catalog, and search keys for online retrieval.

a - ARTICLE --  
article in journal

ad - ADVERTISEMENT --  
advertisement, from newspaper, periodical (compare br - brochure; pg - meeting program).

b - BOOK --  
for commercially published work, usually hardbound.

bl - BIBLIOGRAPHY --  
may be a separate, or a part of a larger work primarily coded ch

br - BROCHURE --  
for separate promotional material, even 1 page.

ch - CHAPTER --  
chapter or portion of book not a proceedings volume.

d - DRAFT --  
use when stated or known to be a draft, not a finished product

ds - DISSERTATION

f - FILM --  
Use for movie or sound. Not for microfiche

g - PROCEEDINGS --  
use when \*cl is a proceedings volume.  
When a paper \*cl from a proceedings is indicated, use p.

gr - GRAPH OR CHART --

i - ABSTRACT OR REVIEW --  
Use when the item catalogued is an abstract or review, as well as bracketing the word following the title in \*cl.

j - ARC OR NIC JOURNAL ITEM

k - PERIODICAL, NEWSPAPER --  
periodical, newsletter, journal, use when journal, etc. in its entirety is meant. For an article use a, for a newsletter issue use n.

l - LETTER --  
Use for a personal letter or where the term appears.  
For an unspecified letter to several addressees, usually use m.

lt - TRANSMITTAL LETTER

m - MEMO --  
Use when the term appears, and when a group of addressees are indicated.

ma - MAP --

n - NEWSLETTER ISSUE --  
A newsletter as an entity, not a specific issue, should be indicated i.

p - PAPER --  
Use for an individually issued preprint or reprint of a presentation, as well as for a paper.

pg - PROGRAM --  
Program of meeting, including first announcements. When ARC member is speaker, etc., indicate in abstract, and note in keywords: e.g., DCE speaker.

pi - PICTURE, PHOTO --  
Use for references to photographs or pictures when separately catalogued in \*cl.

pr - PROPOSAL

qu - QUESTIONNAIRE

r - REPORT --  
Use for technical reports and short publications not known to be articles, papers, etc.

re - PRESS RELEASE --  
Intended for announcements so labelled, and other announcements not meeting programs, advertisements, or brochures.

s - SLIDE

sp - SPECIFICATION, STANDARD

t - TALK --  
Use for an oral presentation recorded on audio or video tape, and for a written version of an oral presentation not expected to be published.

th - THESIS

tr - TRANSLATION --  
May be accompanied by original or original may be separately cataloged, e.g., an original in Japanese may be attached to a translation, rather than separated.

u - FUNCTIONAL DOCUMENT --  
Use when major content of the document is subject to addition, deletion or substitution. Examples are directories or catalogs.

z - CONTENTS OF FUNCTIONAL DOC --  
Use as primary code for any document made a part of a functional document. In conjunction, use \*c2 to contain the name of the functional document. Examples: \*c2 Part, ARPA Network Presource Notebook. \*c2 Section 3, Network Information Center User Guide.

\*f2 MEDIA

a - CARBON COPY --  
Use if copy in hand is a carbon copy.

c - COPY, NOT ORIGINAL --  
If photocopy received at ARC is obviously a copy made of an existing document such as a periodical article.

f - FILM --  
Use for movie and/or sound film. Not for microfiche.

l - MICROFILM --  
Use for roll microform.

m - MICROFICHE --  
Use for items on sheet film.

o - ORIGINAL --  
Original as first issued. Use c if photocopy received at ARC is obviously a copy made of an existing document e.g., a periodical article. Use p if copy is a photocopy made at ARC. Use a if copy in hand is a carbon copy.

p - PHOTOCOPY BY ARC --  
Use for photocopy made at ARC. Compare pa.

pa - PARTIAL PHOTOCOPY  
Use for photocopy of cover, title page, etc. sometimes made to capture part of a document when the whole is not obtainable or retainable.

r - MACHINE READABLE --  
Use to indicate existence of item in machine readable form. May be used in addition to o, etc.

s - SLIDE --  
Use to indicate a chart, photograph etc, is in form of slide.

t - PAPER TAPE --  
Use to indicate existence on paper tape.

x - REFERENCE --  
Used to indicate ARC has recorded the reference but does not have the full document.

\*f3 SOURCE FILE NAME --  
Use for name of machine file if document is machine-readable.

\*m1 SPONSOR OF MEETING --  
Name of sponsor of conference or meeting. Use for name of organization holding or sponsoring meeting.

#1 NAME OF MEETING --  
examples: Conference On Image Transmission. Annual meeting.

#5 CITY, STATE OF MEETING

\*n1 ITEM THAT INCLUDES THIS ITEM --  
ARC number of item that includes this item. Use to record ARC number of book, Proceedings, transmittal letter, etc., where item in hand is a part, attachment, or enclosure. Example: 5606

\*n2 ITEMS(S) THIS ITEM INCLUDES --  
ARC number(s) of item(s) this item includes. Use to record ARC numbers of subordinate parts or enclosures, etc. of item in hand. Example: 5603 5604

\*n3 DOC(S) THIS ONE SUPERCEDES --  
ARC number of document this supercedes. Use to record document superceded, in conjunction with element \*d1 on citation for that document.

\*n4 DOC(S) TO WHICH THIS REFERS --

ARC number(s) of ARC document(s) to which this refers. Use to record explicit reference by document in hand to other ARC documents.

- \*n5 DOC THIS ABSTRACT DESCRIBES --  
ARC number of document this abstract describes. Use to record number of complete document when a condensation is in hand.
- \*n6 DOC(S) THIS ONE ACCOMPANIES --  
ARC number(s) of documents this one accompanies. Use to record transmittal letter for doc, and such.
- \*n7 DOC(S) TO WHICH THIS ONE IS RELATED --  
Use for related documents not necessarily received or filed together.
- \*p1 PROJECT NAME ASSIGNED BY ISSUER --  
Use when explicit; use for code names. Examples: Project MAC; MEDLARS
- \*p2 PROJECT NUMBER ASSIGNED BY ISSUER --  
Use when organization assigns a project number, often in addition to a sponsoring agency's number.
- \*r1 NUMBER(S) ASSIGNED BY ISSUER --  
Serial or or code number(s) assigned by issuer. Use for serial or codes assigned to the individual title by the agency issuing it. Examples: TM 42; Report 17; SBN 13-165969-3
- \*r2 NUMBER(S) ASSIGNED BY GOVT AGENCY --  
Serial or code number(s) assigned by government. Use for numbers assigned to individual report titles. Examples: AD 651 730; PB 117 190; LC 70-79429
- \*s1 SPONSORING AGENCY --  
Use for funding agency, private or governmental.
- \*3 SUBORGANIZATION --  
Use for most significant subdivision of relevant sponsor, skipping #2 unless an intermediate is important for clarity.
- #5 CITY, STATE, ZIP --  
Use in full.
- #6 CONTRACT OR GRANT NUMBER --  
Use as given, excluding "No." or "#".
- #7 PROJECT NUMBER --  
Use for sponsor's project number if any
- #8 ORDER NUMBER --  
Use for sponsor number so designated
- #9 OTHER NUMBER --  
Use for any other number(s) attached by the sponsor
- \*s2 SECOND SPONSORING AGENCY --  
Use for second sponsor with same subelements as \*s1
- \*w1 DATE RECEIVED AT ARC --  
Use form: 12-27-70
- \*w2 DATE CATALOGED AT ARC --  
Use form: 12-28-70
- \*w3 INITIALS OF CONTRIBUTOR --  
Use for attribution to ARC source when desired. Use form: dce
- \*w4 SOURCE IF NOT \*w1, \*w2, or \*w3 --  
Use as credit to donor or as indication of future source. Examples: John F. Bennett, IBM Los Gatos; CFSTI; ERIC CLIS
- \*w5 CLERK SUBMITTING FOR AUTHOR --  
Ident of person creating online file for author
- \*w6 DATE LAST EDITED --  
Use when changing a statement
- \*w7 IDENT OF PERSON CHANGING --  
Used with \*w6 when changing a statement
- \*y1 BRIEF ABSTRACT --  
Use abstract in report, if brief and informative. Use modified abstract from copyright notice, publication. Use for clarification when title is not informative. Use (with (L) in title) for statement of any limitation imposed on the contents or citation. Example: LIMITATION: This document not to be cited.
- \*y2 KEYWORDS FROM DOC OR AUTHOR --  
Keys to subject content. For keywords assigned by report producer or NTIS, etc.
- \*y3 KEYWORDS ASSIGNED AT NIC --  
Keys to subject content. For keywords assigned by NIC in absence of ones given in the document or index.
- \*y4 KEYWORDS ASSIGNED AT NIC --  
For use in special cases.

\*y8 "UPDATED BY xxxx;" "UPDATES xxxx;" "OBSOLETE xxxx;" --  
Documents updated or obsoleted.

\*y9 "OBSOLETE BY xxxx" --  
Notice of documents which obsoletes

\*z1 NIC HOLDINGS --  
Use when transmission or general distribution is made. Examples: All; MAC, SDC, UCSB

\*z2 SUBCOLLECTION --  
Use to indicate status of an item as a part of one or more subcollections. Examples: NIC, NAS, NIC SHF, NIC NWG

\*z3 ARC CATALOG MANAGEMENT CODES --  
ARC master catalog management descriptions. Use for notation of data management, such as form of entry. Examples: old, Walt 1; new

\*z4 ARC HOLDINGS --

\*z5 LOCATION(S) OF COPY --  
e.g., original DCE; partial photo ARC.

## DOCUMENT CONTROL DATA - R &amp; D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

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During the second year of current work, ARC put its major effort into three categories of its investigation: development of augmented management and operational techniques for running a research intelligence system, further building of the data base, and improvement of the computer aids supporting the processes. A "People Services Operation" was established with procedures to aid throughput of incoming information and entry into the data base. Procedures for citation formation and citation file-building were refined, and the data base was expanded using these. Progress was made in development of a coordinated automatic process for entry and storage of catalog data and for catalog and index production.

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Research Intelligence System online system ARPA Network Intellect Augmentation Man-Machine Communication NLS TNLS DEX Deferred Execution of Input Catalog File-building Data Elements						



